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RUSSIAN MARITIME REGISTER OF SHIPPING

RULES

FOR THE CLASSIFICATION AND CONSTRUCTION OF NUCLEAR SUPPORT VESSELS

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RULES
FOR THE CLASSIFICATION AND CONSTRUCTION OF NUCLEAR SUPPORT VESSELS

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The Rules for the Classification and Construction of Nuclear Support Vessels have been approved in accordance with current Regulations and come into force on the date of their publication.

The Rules set forth specific requirements for nuclear support vessels, take account of the provisions of the Code for the Safe Carriage of Irradiated Nuclear Fuel, Plutonium and High-Level Radioactive Waste in Flasks on Board Ships adopted by IMO Assembly at the 18th session on 4 November 1993 (Resolution A.748(19), are supplementary to the Rules for the Classification and Construction of Sea-Going Ships of the Maritime Register of Shipping.

This edition of the Rules is a revision of the Rules for the Classification and Construction of Nuclear Support Vessels, 1982, with updating of a number of the requirements, which appeared necessary, based upon the results of operating of nuclear support vessels.

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CONTENTS

1. GENERAL PROVISIONS

1.1 APPLICATION

1.1.1 Rules for the Classification and Construction of Nuclear Support Vessels[1] apply to all self-propelled and non-self-propelled vessels intended, as defined in 1.2.9, for servicing nuclear powered ships and/or nuclear steam supply systems of sea-going ships (NSSS).

1.1.2 Rules for the Classification and Construction of Sea-Going Ships of the Russian Maritime Register of Shipping[2] are totally applicable to nuclear support vessels and Rules for the Classification and Construction of Nuclear Powered Ships[3] apply as far as references are made in the Rules thereto.

The present Rules regulate only the requirements for special equipment and structure of the vessels, which are to be provided in connection with its special purpose and which may affect to a certain extent safe navigation of the ship, safe-keeping of cargoes and equipment on board, safety of people and the environment.

1.2 DEFINITIONS AND EXPLANATIONS

Definitions and explanations concerning general terms of the Rules are given in the General regulations for the Supervision.

For the purpose of these Rules, the following definitions specific for nuclear support vessels have been adopted:

1.2.1 Decontamination equipment is the equipment intended for radioactive contamination removal from different surfaces.

1.2.2 Controlled area is a number of spaces where exposure to a higher level of ionizing radiation and/or radioactive contamination may occur during normal operation, access therein is controlled.

1.2.3 Monitored area is a number of spaces where radioactive contamination may occur and ionizing radiation is likely to increase in case of variations from normal operation of the equipment.

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[1] Hereinafter referred to as the Rules.

[2] Hereinafter referred to as the RS Rules.

[3] Hereinafter referred to as the Rules for Nuclear Powered Ships.

1.2.4 New fuel assemblies are fuel elements assemblies before they are used in a nuclear reactor.

1.2.5 Spent-fuel assemblies are fuel elements assemblies extracted from a nuclear reactor, whatever their energy content may be.

1.2.6 Radioactive waste equipment is equipment intended for radioactive waste collection, treatment and storage.

1.2.7 Personnel (occupationally exposed persons) is part of the crew, occupationally exposed to ionizing radiation.

1.2.8 Radioactive wastes are products, materials, media contaminated with radioactive substances in amounts exceeding the values established by the Rules and Regulations in force and not subject to further use.

Radioactive wastes may be solid, liquid and gaseous.

1.2.9 A nuclear support vessel is a cargo ship intended for:

storage of new and spent fuel assemblies of nuclear reactors;

spent fuel assemblies unloading from and new fuel assemblies loading into reactors;

NSSS equipment reception, decontamintion, repairs and storage;

Gaseous, liquid and solid radioactive waste reception, treatment and transfer;

supply of nuclear powered ships with working media and their reception on board;

supply of nuclear powered ships with electrical and thermal power;

other functions of operational support of nuclear powered ships and personnel.

Such vessel can provide the whole complex of operational support or individual types thereof, which determines the design of the nuclear support ship, of the equipment installed thereon and its nomenclature.

2. CLASSIFICATION

2.1 CLASS NOTATION OF A SHIP

2.1.1 If a vessel complies with certain requirements of the RS Rules, Rules for Nuclear Powered Ships and these Rules, a descriptive notation "nuclear support vessel" according to the particular purpose of the vessel is added to the character of classification as defined in Part I "Classification" of the RS Rules. Operational characteristics of the vessel according to its

particular purpose are mentioned as additional characteristics in column "Other characteristics" of the Classification Certificate.

2.2 CLASSIFICATION SURVEYS OF NUCLEAR SUPPORT VESSELS AND THEIR EQUIPMENT

2.2.1 The Register performs its supervision activities in compliance with the General Regulations for Supervision of the RS Rules. They include consideration and approval of technical documentation, supervision of the manufacture of materials, products and equipment as well as supervision during construction of the ship and in process of its operation.

2.2.2 The nomenclature of the subjects of supervision, form and scope of the Register's supervision are established on the basis of the nomenclature and forms of supervision, specified in the RS Rules, Rules for Nuclear Powered Ships with due regard to the purpose of the nuclear support vessel.

Technical requirements for subjects of supervision are given in relevant parts of the Rules.

2.2.3 Special process equipment installed on a vessel is subject to technical supervision of the Register in terms of:

.1 cargo-handling machinery and gear;

.2 pressure vessels;

.3 electrical equipment.

Technical supervision of the above items of the special process equipment is carried out in accordance with the requirements of Part X "Boilers, Heat Exchangers and Pressure Vessels" and Part XI "Electrical Equipment" of the RS Rules, Rules for Cargo-Handling Gear of Sea-Going Ships and the requirements of these Rules, where appropriate.

2.2.4 At the Register decision the number of items of supervision of special process equipment may be increased.

2.3 TECHNICAL DOCUMENTATION ON NUCLEAR SUPPORT VESSELS

2.3.1 Technical Design of a Ship under Construction.

In addition to the documentation to be submitted to the Register for consideration according to the requirements of Part I "Classification" of the RS Rules, the following technical design documentation is to be presented for nuclear support vessels:

2.3.1.1 General:

.1 plan of ship's subdivision into areas;

.2 general arrangement plan of controlled area spaces with their subdivision into categories and indication of all openings and their closures in hull structures bounding the controlled area;

.3 structural arrangement of biological shielding.

2.3.1.2 Hull documentation:

.1 side and bottom collision and grounding protective structure in way of spent-fuel assemblies storages and liquid radioactive waste tanks;

.2 drawings and strength calculations of liquid radioactive tanks with indication of distances between side and bottom shell plating and the tanks;

.3 drawings of supports and other structures for securing built-in liquid radioactive waste tanks;

.4 scheme of integrity and leak tightness tests of controlled area compartments.

2.3.1.3 Radiation safety documentation:

.1 basic diagram, description and composition of radiation monitoring;

.2 charts of anticipated radiation levels in the interior spaces of the vessel and on outer surfaces of hull structures with spent fuel assemblies, liquid and solid wastes storage facilities totally filled;

.3 charts of anticipated radiation levels in the interior spaces of the vessel (accommodation and controlled area spaces) and in the vicinity of the vessel in the course of handling operations;

.4 efficacy calculations of biological shielding for spent fuel assemblies, liquid and solid radioactive waste storage facilities, spaces where personnel can stay, made or approved by a competent authority;

.5 radiation conditions evaluation in case of the most serious accidents and charts and calculations of anticipated radiation levels in case of accidents in the interior spaces and in the vicinity of the vessel, approved by a competent authority;

.6 description of decontamination procedures for spaces and equipment subject to radioactive contamination; for equipment and materials transferred from serviced ships as well as contaminated and decontaminated equipment and materials transfer routes. Description and arrangement plan of the main decontaminating equipment.

2.3.1.4 Documentation on pumping and piping:

.1 basic diagrams of water and air systems serving spent fuel assemblies storage facilities and liquid radioactive waste tanks, of liquid radioactive waste reception and discharge systems;

.2 basic diagrams of ventilation systems for spent-fuel assemblies and solid radioactive waste storage facilities, the spaces where they are located, liquid radioactive tank spaces, equipment storage spaces and the controlled area as a whole;

.3 basic diagram of fire fighting and signalling systems in the vessel controlled area;

.4 basic diagram of waste water and special bilge systems of the vessel controlled area spaces;

.5 calculations on pumping and piping of spent-fuel assemblies storage facilities, liquid radioactive waste tanks and liquid radioactive waste reception and discharge control station.

2.3.1.5 Documentation on electrical equipment:

.1 drawings of cable routing in the controlled area with cable penetrations of the biological shielding and divisions between the controlled and monitored areas;

.2 arrangement plans of electrical equipment of handling means;

.3 basic diagrams of process and heat monitoring and signalling as well as alarm systems;

.4 arrangement of the equipment in the main control room;

.5 list of control, monitoring and signalling parameters of special systems;

.6 drawings of control and monitoring console of propulsion and ship systems, liquid radioactive waste treatment facilities (if any) and radiation monitoring.

2.3.2 Detailed plans for a ship under construction:

In addition to the documentation specified in Part I "Classification" of the RS Rules, the following detailed design documentation is to be submitted for a nuclear support ship:

2.3.2.1 Hull documentation:

.1 drawings of main structural members of the controlled area spaces and their attachments to hull members;

.2 drawings of spent-fuel assemblies storage facilities with closures, liquid radioactive waste built-in tanks and their foundations;

.3 arrangement plans of openings in bulkheads and decks bounding the controlled area and their closures.

2.3.2.2 Documentation on radiation safety:

.1 arrangement plans of the process radiation monitoring system equipment;

.2 testing programme of the radiation monitoring system at the Manufacturer;

.3 drawings of biological shielding of the controlled area spaces, special equipment, pipes for radioactive material transfer and special fittings.

2.3.2.3 Documentation on pumping and piping:

.1 drawings of pipes of the systems listed in 2.3.1.4 of the Rules with indication of fittings, pipe fastenings and penetrations through gastight bulkheads and biological shielding;

.2 installation (location and mountings) of bottom and side fittings in the vessel controlled area.

2.3.2.4 Documentation on electrical equipment:

.1 circuit diagrams of main and emergency electrical power supply to consumers (fixed and portable), directly associated with the vessel use for the intended purpose;

.2 circuit diagrams of main and emergency electrical power supply to automation, monitoring and signalling devices;

.3 calculation of the required electrical power capacity providing main operating conditions of the vessel.

3. HULL

3.1 A ship designed for reception and storage of spent-fuel assemblies and/or medium-activity waste is to have collision, grounding and stranding protection referred to in Part IV "Hull" of the Rules for Nuclear Powered Ships.

3.2 Double skin side structure is to be provided in way of the spaces intended for spent-fuel assemblies and radioactive waste storage. Longitudinal bulkheads are to be positioned at a distance equal to at least 1/5 of the vessel breadth from the vessel's side, except the cases where collision protection prevents that deep damage. Proof is to be presented to the Register that penetration limit in case of collisions assumed in the design of the vessel will not be exceeded.

3.3 Decks, platforms and deck covers which can be used for permanent or temporary storage of heavy equipment (containers, trans-shipment appliances, etc.) are to be of adequate strength and fitted with fixed or detachable supports and fixing devices in accordance with the RS Rule requirements.

Deck covers of spaces for new and spent-fuel assemblies, solid radioactive waste storage are to have sectional structure allowing for their partial opening.

3.4 Provision is to be made for reliable securing of the shielding, designed with due regard for the acting inertia forces and likely design accidents.

3.5 The controlled area spaces are to be designed to allow for decontamination of the surfaces.

.1 The bulkhead members are to be fitted on the side of the spaces with less probability of contamination.

.2 The hull structure, including foundations, is to prevent stagnation areas in the course of decontamination.

.3 Design of the foundations and machinery and equipment attachments is to allow for decontamination. The foundations inaccessible for decontamination are to be sealed.

3.6 The fire safety of nuclear support vessels is to comply with the requirements of Part VI "Fire Protection" of the Rules for Nuclear Powered Ships. The fire protection of the controlled area spaces of nuclear support vessels is to meet additional requirements placed upon the reactor compartment spaces of nuclear ships.

4. STABILITY, SUBDIVISION

4.1 Nuclear support vessels are to comply with the requirements of Part IV "Stability" and Part V "Subdivision" of the RS Rules and Part V "Subdivision" of the Rules for Nuclear Powered Ships, having regard to the following:

4.1.1 A nuclear support vessel designed for storage (transportation) of spent-fuel assemblies and/or medium-activity radioactive waste is to remain afloat, and intact ship stability under all loading conditions corresponding to the purpose of the ship is to be sufficient to meet the requirements of the Rules for Nuclear Powered Ships for damage stability in case of (side and/or bottom) damage in any place lengthwise.

4.1.2 Subdivision requirements for a nuclear support vessel designed for other purposes than those referred to in 4.1.1 are subject to special consideration by the Register, having regard to the purpose, design and service area of the ship, but, in any case, intact stability is to be sufficient for meeting the requirements of the Rules for Nuclear Powered Ships for damage stability in case of side and/or bottom damage in any place lengthwise between two nearest bulkheads.

5. GENERAL REQUIREMENTS FOR NUCLEAR SUPPORT VESSELS

5.1 Along with general purpose systems and facilities, nuclear support vessels are to have, depending on service conditions and intended use, the following additional systems and facilities.

5.1.1 Facilities for safe reception, storage and discharge of spent and new fuel assemblies of nuclear reactors, as well as facilities and equipment for spent-fuel assemblies loading into transport containers.

5.1.2 Facilities for solid radioactive waste reception, storage and discharge.

5.1.3 Liquid radioactive waste reception, storage and discharge systems and facilities, intended for segregated reception and storage of liquid radioactive waste different in terms of their volumetric activity and their discharge to the shore or to another vessel. Liquid radioactive waste tanks are to be located in the controlled area spaces of different categories. Liquid radioactive waste classification in terms of their volumetric activity and categorization of the controlled area spaces are regulated by the national Sanitary Rules.

Where a nuclear support vessel is intended for reception and storage of large quantities of liquid radioactive waste, it is recommended that provision be made in the system for water treatment plant to decrease a volumetric activity level of liquid radioactive waste to be stored.

5.1.4 Waste water and special bilge systems intended for collection of the vessel's own active water from the controlled area spaces, their storage and discharge.

A system is to be provided for collection of radioactive media from where they are likely to arise and their discharge into a special tank.

5.1.5 Decontamination and spraying (washing) systems of process spaces and decks, intended for reception and storage of decontaminating solutions concentrated ingredients, solution preparation and supply to the areas of decontamination and subsequent spraying (washing) of decontaminated items or surfaces.

5.1.6 Controlled area ventilation system which is to be independent of the vessel's ventilation system.

5.1.7 Compressed gas (air, nitrogen, etc.) systems for process needs, which are to be independent of similar general-purpose systems of the vessel.

5.1.8 Liquid radioactive tank cofferdams heating system which is to be independent of the general-purpose heating system of the vessel.

5.1.9 Reception, decontamination and storage facilities for different nuclear steam supply system equipment.

5.1.10 Integrity and leak tightness testing is to be provided for systems and facilities without putting a nuclear supply vessel out of service. Working media are allowed to be used for such testing.

5.1.11 Vessels intended for reactor cores loading/unloading or only for spent and new fuel assemblies reception, storage and discharge are to be fitted with trim and cross-flooding systems and fittings to maintain equilibrium of the vessel during handling operations.

5.2 Liquid radioactive waste tanks, spent and new fuel assemblies and solid radioactive waste storage facilities are to be located in special spaces totally complying with the Rules requirements.

5.3 Biological shielding is to be provided for spaces referred to in 5.2.

5.4 Spent fuel assemblies storage facilities and liquid radioactive waste tanks are to be of built-in design, welded and made of corrosion-resistant materials. Their framing, strengthening in support locations, etc. are to be made on the outside. Water collectors fitted with efficient drainage arrangements are to be provided at the bottom of the tanks. The tank bottom slope to the water collector is to provide water discharge under any operating list or trim of the ship. Drainage pipe shut-down valves are to be installed either on the tanks directly or (in case biological shielding is provided) on the branch pipes of adequate strength. The storage facilities and tanks are to be surrounded by cofferdams. The possibility of using integral tanks for low-activity liquid radioactive waste storage is to be proved and agreed with a competent authority and approved by the Register.

Where necessary, liquid radioactive waste tank cofferdams are to be provided with heating system. Where steam heating is used, condensate collection and storage are to be separated from ship general systems. Steam and condensate discharge into the atmosphere is not allowed. Corrosion-resistant materials are to be used for the manufacture of the heating system. Heating elements installation inside the tanks is not allowed.

5.5 Storage facilities for spent fuel assemblies, liquid and solid radioactive waste are to be arranged as far as possible from accommodation spaces and spaces where people can stay.

It is recommended that accommodation spaces and spaces where people permanently stay be segregated from the controlled area by process spaces.

5.6 Double bottom tanks located below spent fuel assemblies, liquid and solid radioactive waste storage facilities are not allowed to be used for potable and washing water storage.

5.7 Minimum equipment necessary is to be installed in the controlled area spaces. The arrangement of such equipment, pipes, cable runs is not to prevent proper decontamination of hull structures and equipment itself. The number of transit pipes, cables and other services through these spaces and their length are to be kept to a minimum, and they are to be laid in sealed corridors, linings or conduits.

5.8 Bilge wells of the controlled area spaces are to be protected with screens preventing the wells contamination by foreign matters and provided with indicators showing the presence of water therein.

The pipes in the sealed spaces to discharge water from the bilge wells are to be fitted with shut-down devices with position indicators, the information being displayed on a control panel in the main handling operations control room.

5.9 The controlled area spaces where aerosols might arise are to have closing devices capable to provide their tightness.

The closing devices are to be fitted with "open-closed" position indicators, the information being displayed on a control panel in the main handling operations control room. Every closing device is to be numbered.

5.10 In addition to the controlled area spaces, a list of individually sealed spaces is to be presented including potable water tanks, provision stores and other spaces where equipment or outfit necessary for life support of the ship and its crew is located. The list of such spaces is to be agreed upon with the Register.

5.11 No machinery of the vessel systems as well as bottom and side fittings serving the systems may be located in the controlled area. Where such machinery and equipment are to be placed outside the machinery space for serving the remote controlled area spaces, a special compartment is to be enclosed outside the controlled area. The compartment is to have a separate entrance from the upper deck and to be provided with independent bottom and side fittings. Such machinery may include ballast, fire and bilge pumps and other machinery. The number of bottom and side fittings for the controlled area equipment serving is to be kept to a minimum.

5.12 Nuclear support vessels intended for reactor cores reloading, new and spent fuel assemblies and solid radioactive waste transportation and storage are to have the main handling operations control room.

The control room is to be provided with:

.1 visual and audible water level indication in the spent fuel assemblies storages and tanks;

.2 thermal control instruments for spent fuel assemblies storages and heat-exchange equipment;

.3 position indicators for pipe fittings of special systems;

.4 means for operation signalling of electric pumps and heat exchangers of special systems and monitoring of their parameters;

.5 means for water presence signalling in the bilge wells of the special bilge system in the controlled area spaces;

.6 radiation monitoring information means for ships spaces, open decks, ventilation exhaust outlets of the controlled area ventilation system and places of possible uncontrolled release of radioactive gases or aerosols;

.7 alarms operating in case of emergency in the new and spent fuel assemblies storage spaces;

.8 alarm signals for the personnel evacuation from the dangerous area (see 8.6.4 of the Rules);

.9 information means for controlled area ventilation operation and vacuum in the spaces with indication of fan operation and valve positions;

.10 means for two-way communication with the ship machinery space, valve control station, new assembly preparation room and main work places in the controlled area, including positions from where cargo cranes operating with new and spent fuel assemblies are controlled;

.11 means for two-way communication with the station from where repairs of the served ship are controlled;

.12 teleobservation system for the controlled area spaces where potentially hazardous works are performed as well as for new and spent fuel assemblies storage spaces.

All control, monitoring and signalling equipment in the main handling operations control room is to be combined on special panels which, in addition to main electrical power supply, are to be fed from emergency sources of electrical power to be automatically connected.

5.13 Fittings of process systems dealing with liquid radioactive waste pumping are to be positioned in an enclosure provided with biological shielding and controlled from the valve control station adjacent to the fitting enclosure.

The valve control station is to be fitted with information means referred to in 5.12.1, 5.12.3 to 5.12.5 of the Rules. The fitting enclosure coating is to be suitable for multiple decontamination.

The length of the pipes and the number of fittings are to be minimized, the pipe connections with fittings and other pipes are to be welded (except for detachable pipes). The fittings are to have bellows seals. The pumps for liquid media are to be electrically driven, have no glands (tight construction). All special-purpose systems of nuclear support vessels are not to be connected with vessel's general-purpose systems.

5.14 Permanent special process equipment may have energy supply (electrical power, compressed gases, etc.) directly from vessel's general-purpose systems (for compressed gases see 7.4 of the Rules). Non-permanent process equipment is to have energy supply from self-contained energy stations through regular detachable facilities.

5.15 Cargo-handling facilities in the controlled area spaces are to be of an enclosed design and accessible for decontamination. The lowering-hoisting mechanism is to have a wide speed range, including the lowest speeds. Where a cargo handling gear is controlled from a cabin, access to the cabin is to be from a space outside the controlled area.

Cargo-handling gear is to meet the requirements of the Register Rules for Cargo-Handling Gear of Sea-Going Ships.

Necessity to move different equipment, apparatus, instruments, etc. is to be kept to a minimum. For this purpose provision is to be made in the controlled area for special spaces equipped for necessary repairs, adjustments and testing of the main technical facilities installed in the controlled area.

5.16 Provision is to be made for reception of pure process media (water, steam, gases) from the outside and their discharge to the served ship or to the shore.

5.17 Equipment of the special spaces (special-purpose sanitary spaces, laboratories, workshops) is subject to the Register's supervision in terms of the energy supply thereto and safe operation of pressure vessels.

6. FUEL ASSEMBLIES AND SOLID WASTE STORAGE FACILITIES

6.1 NEW FUEL ASSEMBLIES STORAGE FACILITIES

6.1.1 Where provision for new fuel assemblies storage is made on board the vessel, an appropriate space is to be fitted with racks for new fuel assemblies storage in the position and in the state indicated in the

manufacturer's Specifications and Nuclear Safety Rules, as well as with fittings for installation and secure fastening of transport containers with new fuel assemblies.

6.1.2 The number of pipes passing through the spaces containing new fuel assemblies storage facilities is to be kept to a minimum. Installation of steam pipes in the new fuel assemblies storage spaces is not allowed, pipes for other purposes within such spaces are to have permanent joints. The spaces are to be equipped with a bilge system. It is recommended that an independent bilge (stripping) system be installed.

6.1.3 The new fuel assemblies storage space is to be provided with a properly equipped assemblies condition incoming control station and a station for preparation of new fuel assemblies for process operations. The latter is to have two-way communication with the main handling operations control room.

In order to provide handling operations of new fuel assemblies loading into the nuclear reactor, the station is to have two-way communication with the handling operations control station of the serviced ship.

6.1.4 Transport-handling appliances in the new fuel assemblies storage spaces are to prevent damage of containers with new fuel assemblies or the assemblies themselves in the course of handling operations.

6.1.5 Appliances to be used for heating of new fuel assemblies storage spaces are to prevent air temperature and humidity rising above the values specified in the requirements for new fuel assemblies storage conditions.

6.1.6 The space is to be equipped with a permanent spontaneous chain reaction alarm system. Besides, provision is to be made for use of portable means for radiation level monitoring and alarms in separate locations of the space where short-time operations with new fuel assemblies can be carried out (incoming control stations, places of likely short-time controlled accumulation of new fuel assemblies in the course of handling operations, etc.).

6.2 SPENT FUEL ASSEMBLIES STORAGE FACILITIES

6.2.1 Where spent fuel assemblies might be stored on board the vessel the following is to be provided:

.1 special storage facilities of adequate capacity, having fittings for fixing the covers. The main items of storage facilities (covers, plugs, etc.) are to be unified, but they are to be properly marked to identify the particular set they

belong to. Closures of individual cells (boxes, holders) as well as those of every section and the whole storage facility are to have reliable stoppers to prevent them from spontaneous opening in case of the ship motion.

Storage facilities are to have radiation protection which reduces an equivalent radiation dose power on exposed surfaces down to the magnitudes specified in the national Sanitary Rules and Radiation Safety Standards;

.2 devices for directing and accurate placement of each individual spent fuel assembly of the core in the box cell or storage facility holder;

.3 devices for spent fuel assemblies boxes safe loading and unloading from storage facilities and transfer thereof to the shore transport means or special vessels;

.4 an independent storage facility or section with appropriate equipment to receive and store emergency spent fuel assemblies. If storage of such spent fuel assemblies is provided, the storage facility is to be fitted with a separate exhaust ventilation duct. Design provisions are to be made to prevent such space from flooding it with water;

.5 a possibility to carry out radiation — hazardous handling operations with spent fuel assemblies in the spaces isolated from the environment. It is recommended to install an alarm system preventing such operations in case of seal failure of the spaces.

The design is to be such as to prevent or at least minimize any possibility of radioactive gases or aerosols uncontrolled release during loading or unloading of spent fuel assemblies storage facilities. Provision is to be made in storage spaces for local air sampling to measure radioactive gases or aerosols volumetric activity.

6.2.2 Spent fuel assemblies storage facility is to be suitable for storage of all core rods. Sectional storage facilities (for several assemblies) are allowed.

The design of the top plates of the storage facility closures is to allow for their partial opening. Besides, provision is to be made inside the storage facility for a cover for each individual spent fuel assembly or groups of spent fuel assemblies in case several spent fuel assemblies are supposed to be kept in one box, in order to reduce a combined radiation level in the course of handling operations with spent fuel assemblies.

The design of spent fuel assemblies storage facilities is to provide nuclear and radiation safety and prevent self-supporting nuclear chain reaction under any spent fuel assemblies storage conditions possible. Biological shielding of storage facilities is to provide radiation protection in case they are loaded with the highest activity spent fuel assemblies.

6.2.3 Spent fuel assemblies storage facilities are to be made of stainless steel. The interior surface coatings of storage spaces and equipment are to allow for multiple decontamination thereof.

The design of spent fuel assemblies storage facilities and their equipment are to provide a possibility for their drainage, periodical internal examinations and necessary repairs.

6.2.4 Where spent fuel assemblies are to be stored under continuous residual heat dissipation conditions, a double-circuit cooling system is to be provided. Every circuit is to work a closed-cycle principle. In case of sectional storage facilities, heat dissipation is to be provided from each section separately. High-purity process water is to be generally used as a heat-dissipation medium in both circuits. The second circuit heat carrier may be cooled in heat exchangers cooled with sea water by vessel's general-purpose means.

From the first and second cooling circuits standby heat dissipation means are to be provided in the cooling system. Both main and standby heat dissipation means are to be supplied with electrical power from the main and emergency sources of electrical power. Continuous heat carrier activity monitoring of the first cooling circuit and at least periodic monitoring of the second circuit and sea water at the heat exchanger outlet are to be provided.

Means are to be provided in the heat dissipation system for mechanical impurities and radioactive contamination removal. Fittings installed directly on the storage facilities are to be remote controlled and have position indicators with displaying the information on their position in the main handling operations control room and in the valve control station. Where provision is made for local control of the fittings, they are to have an appropriate biological shielding. In this case, local position indicators (see 5.4 and 5.13 of the Rules) of the fitting position are to be provided as well.

6.2.5 Spent fuel assemblies storage facilities are to be provided with a process water sectional flooding system, a bilge system and independent ventilation system with air intake from under closures (upper plates) of the storage sections to prevent water from being entrained into the ventilation system (see 7.5.5 of the Rules).

6.2.6 The capacity of the equipment (pumps, heat exchangers, etc.) serving the systems of the spent fuel assemblies storage facilities is to be based on the calculation with due regard for possible design accidents. The storage flooding or emptying rates are to be proved.

6.2.7 Where spent fuel assemblies are loaded directly into the storage facility (section, container) filled with water, the storage facility is to be fitted with an overflow system for water excess being overflown into a special overflow tank to be installed according to 5.4 of the Rules and fitted with air pipes of an adequate cross-sectional area and continuously operating remote level indicators with information being displayed in the main handling operations control room. Provision is to be made for high and low level audible alarms to operate in the same control room. The overflow tank capacity is to be proved by calculation. The tank may be located outside the storage space. In such case, the overflow pipes and the tank are to have biological shielding.

It is allowed to provide one overflow tank for all sections of the spent fuel assemblies storage facility. In this case, however, its capacity is to be increased, and any possibility of water overflow from one section into another through the overflow pipe is to be prevented.

For overflow tank air pipes requirements, see 7.1.1.8 of the Rules.

6.2.8 The water is to be pumped out of spent fuel assemblies storage facility (or section thereof) or overflow tank with glandless electrically-driven pumps or other means preventing active water leaks. Where such means can operate only when filled with water, provision is to be made for interlocking of their starting only in case of water available in the pumps and stopping upon reaching the lower water level in the spent fuel assemblies storage facilities. A possibility of inadvertent process water drainage and storage facility emptying in case of any pipe damage because of process water ejection due to a "syphon" effect is to be prevented.

6.2.9 Every section of the spent fuel assemblies storage facility (in case of a sectional design) is to be fitted with a heat monitoring system and continuously operating remote process water level indicator with entire level range visual, and upper and lower level audible signalling with information led to the main handling operations control room and the valve control station.

The heat-monitoring system and level-indication system are to be designed so as to allow for repairs and component replacement without emptying the section.

For direct supervision of the handling operations a properly shielded position fitted with two-way communication with the main handling operations control room and repairs control room of the serviced ship is to be provided in the storage facility space.

6.2.10 Upon manufacture and installation on board the overflow tank of the spent fuel assemblies storage facility and systems serving the tank are to be tested for integrity and leak tightness.

Trays made of stainless steel or an appropriate barrier on the deck plating are to be placed under the fittings installed. All pipe connections and fitting-to-pipe connections are to be welded.

6.2.11 Spent fuel assemblies are to be loaded into a storage facility (section) through a special arrangement enabling to coordinate and mate the axes of the transfer container and holders (box cells) in the storage facility plates.

6.2.12 Provision is to be made for an expansion tank for priming of the heat dissipation system of spent fuel assemblies storage facilities, replenishing the leaks and heat expansion compensations.

6.2.13 The sea cooling water for heat dissipation from the secondary-circuit coolant of the storage facility cooling system is to be supplied from at least two independent sea valves. Provision is to be made for sea cooling water supply when the vessel is docked. In order to prevent the secondary-circuit coolant from supercooling at low sea water temperatures provision is to be made for its recirculation, i.e. partial discharge of the sea water into the intake sea valve trunk.

Twin mechanical strainers, one of which is to be in operation, are to be provided in the sea water system.

Use may be made of the sea cooling water from the ship system, provided it meets the requirements of this paragraph and has an adequate capacity reserve.

6.2.14 A special container properly protecting the personnel against penetrating radiation is to be provided for spent fuel assemblies transfer from the nuclear reactor into the storage facility. The container is to be designed so as to allow for its control during spent fuel assemblies unloading from the nuclear reactor and prevent spent fuel assemblies from open transfer.

6.2.15 The design of non-fixed handling equipment working in conjunction with vessel's machinery and arrangements (containers, temporary storage facilities, essential rigging, etc.) is considered by the Register in the course of design and manufacture as specified in 2.2.3 of the Rules in terms of its operational and radiation safety. Places for permanent or temporary storage of heavy handling equipment are to be adequately strengthened, provided with arresting or other fixing devices and biological shielding, where necessary. Technical supervision of the equipment in service is also effect as specified in 2.2.3 of the Rules.

6.3 SOLID RADIOACTIVE WASTE STORAGE FACILITIES

6.3.1 Solid radioactive waste, other than spent fuel assemblies, may be stored in special storage facilities of stationary type (safe cabinets) and of non-stationary type (containers), which are to be located in specially designed spaces.

A special-purpose fixed or transport container is to be provided for storage of changeable or temporarily removable large-sized equipment, if it is required by the core repair or re-loading technology. The container is to be equipped with devices for fixing the transferred equipment inside the container, and heat dissipation and power supply means are to be provided, where necessary.

6.3.2 The storage space is to have a trunk for loading and unloading containers by outside cargo-handling gear or a properly equipped lift. The cargo platform (cabin) of the lift is to be designed so as to prevent the containers or individual loads from sliding when the ship is rolling, loads from dropping into the trunk or creating obstacles for lift platform movement. Provision is to be made for access into the lift trunk for its decontamination and repairs.

The requirements of Section 11 "Cargo Lifts" of the Rules for Cargo-Handling Gear of Sea-Going Ships are totally applicable to the lifts.

The storage space is to be fitted with a cargo-handling gear for moving the containers inside the space.

6.3.3 Stationary storage facilities (safe cabinets) are to be located to minimize the ship list effect on solid radioactive waste handling operations, and their doors, when opened, are not to obstruct the passages in the space. The doors or other closing appliances of the spaces are to be fixed in the open position and locked when closed. It is recommended that the doors be fitted in such a way as to be an additional protective shield when works with open storage facilities are in process. Use of guillotine or folding-down doors is not allowed.

It is recommended that higher activity solid waste is stored separately from lower activity waste.

Where solid radioactive waste types are segregated according to their activity level, different biological shielding of the storage facilities is allowed. The dosage rate on the storage facilities outer surfaces, however, is not to exceed the magnitudes required by the national Sanitary Rules and Radiation Safety Standards.

6.3.4 Stationary storage facilities are to have through notation and door position indication.

6.3.5 The storage facilities and equipment are to be designed to make decontamination possible.

6.3.6 Solid radioactive waste storage facilities and spaces where they are located and where a possibility exists that such waste might develop aerosols or radioactive gases are to have closing appliances providing their leak tightness. The ventilation system of such storages and spaces, where it is a part of the special ventilation system (see 7.5 of the Rules) is to be fitted with aerosol filters and can be combined with the rest of the special ventilation system only at the end of the discharge route.

6.3.7 Portable containers are to be used for radioactive waste collection, temporary storage and transfer to the shore or to other vessels. The containers are to have reliable fittings for their gripping and carriage, the shape and size of the containers are to allow for their transportation along the routes to be used in the course of handling operations.

The container covers are to be securely locked, their shape and size are to provide their integrity under storage conditions.

Where such containers are intended for multiple use, it is recommended that they should be unloaded through the bottom cover. The containers are to have appropriate warning painting and marking.

Provision is to be made for safe storage of the containers preventing their arbitrary movement and damage of the containers themselves and equipment of the spaces.

Where provision is made for storing the containers on open decks of the vessel, any possibility of moisture penetration inside the containers or active particle escape from within is to be structurally prevented. This refers both to the containers structure and structural design of their storage places on board the vessel (shelters for the case of bad weather, etc.).

7. SPECIAL SYSTEMS

7.1 SYSTEMS AND FACILITIES FOR LIQUID RADIOACTIVE WASTE RECEPTION, STORAGE, TREATMENT AND DISCHARGE

7.1.1 Liquid Radioactive Waste Storage Facilities.

7.1.1.1 Special built-in tanks located in the controlled area spaces specially intended for this purpose are to be provided for liquid

radioactive waste reception and storage. Supports and fixtures of liquid radioactive waste tanks are to be designed so as to prevent any loads arising in hull members from being transferred thereupon.

The strength of the liquid radioactive waste tank structures is to allow for their filling up to the top of air or overflow pipes.

7.1.1.2 For liquid radioactive waste storage special tanks are recommended to be provided for keeping medium-activity water. Communication between the medium- and low-activity water storage tanks is not allowed.

7.1.1.3 Tanks for medium-activity water storage are to be made of corrosion-resistant materials and be suitable for multiple decontamination and washing. Such tanks are to have compulsory biological shielding. Where concrete is used for this purpose, the shielding outer surfaces are to be lined with a material allowing its decontamination or replacement.

7.1.1.4 Tanks for low-activity water storage may be made of ordinary constructional materials with subsequent application of anti-corrosive coatings, ship structures and spaces may be used as biological shielding. The efficiency of their protective properties, however, is to be checked by filling the tanks up to the upper level with liquid waste of maximum volumetric activity permitted by the national Sanitary Rules for low-activity water.

7.1.1.5 Liquid radioactive storage facilities are to have:

.1 at least two manholes giving access inside the tanks for cleaning, inspection and repairs;

.2 a system for supply inside the tanks and distribution of decontaminating solutions and steam for their heating;

.3 a system for washing and discharge of decontaminating solutions and washing water;

.4 collecting wells to minimize liquid radioactive waste quantity;

.5 continuously operating remote level indicators with a visual indication within the whole range and audible alarms of the upper and lower levels with information led in the main handling operations control room and valve control station;

.6 a sampling device;

.7 tank ventilation system (air pipes);

.8 a system for liquid radioactive waste overflow from the tanks;

.9 devices to prevent inadmissible pressure increase in the tanks, where necessary;

.10 systems and/or means of removing sediments upon emptying the tanks.

The tanks are to be protected from spontaneous emptying in case of filling or other pipes damage because of process water ejection due to a "syphon" effect.

7.1.1.6 Fittings are to be installed directly on the tanks in readily accessible places, to be of sylphon type and remote controlled. Stainless steel trays are to be provided in the fitting installation area or barriers are to be fitted on the deck (platform) plating to collect leakages in case of sylphon damage.

Where valves are locally controlled, they are to have biological shielding.

The valves are to be provided with local position indicators with extreme position indication in the main handling operations room and valve control station.

7.1.1.7 Tanks permanently or periodically operating under internal pressure are to be subjected after manufacture and then again after installation on board the ship and connection of pipes to a hydraulic test according to the requirements of Part X "Boilers, Heat Exchangers and Pressure Vessels" of the RS Rules.

Tanks operating under hydrostatic pressure are to be subjected after manufacture and then again after installation on board and connection of pipes to hydraulic tests as required by Part II "Hull" of the RS Rules.

Periodical surveys and tests of the liquid radioactive waste storage tanks are to be carried out with intervals specified in Part I "Classification" of the RS Rules. These surveys and tests are generally to be combined with works on tank decontamination, washing and repairs.

7.1.1.8 Liquid radioactive waste storage tanks are to be fitted with air pipes made of corrosion resistant materials. The air pipes from medium-activity waste tanks (see 5.1.3 of the Rules) are to be led from the top part of the tanks to the space where they are located or to a higher category space (in terms of existing or anticipated contamination), if any. The air pipes from low-activity waste tanks may be led to the open deck. In this case the ends of the pipes are to be as high and as far as possible from the spaces where people may stay and air intake of the ship ventilation system is performed. Where special ventilation system is available on board, the air pipes of the tanks are to be led to the ventilation mast. Several air pipes may be combined into one pipe the diameter of which is to be increased accordingly. In this case, however, any possibility of liquid

radioactive waste overflow from one tank into another is to be prevented. An exception is made for a special overflow tank, if any, which is covered by the requirements of 7.1.1.8 and 7.1.1.9 of the Rules. Air pipes of medium- and low activity waste storage tanks may not be combined. Connections of air pipes with tanks and between themselves are to be welded. Pressure/vacuum valves are to be fitted on the outlets of the air pipes of the liquid radioactive waste storage tanks, whatever their volumetric activity may be, and adequate radiation monitoring is to be provided. Low-activity liquid radioactive waste tanks, provided their air pipe emissions are, in the opinion of competent sanitary authorities, not unacceptable for environment, may be exempted from the latter requirement. No shutdown means (except the cases referred to in 7.1.1.10 of the Rules) are allowed on the air pipes.

7.1.1.9 In addition to air pipes liquid radioactive waste tanks operating under hydrostatic pressure only are to be fitted with overflow system for liquid radioactive waste collection and discharge, when main tanks are overfilled; the system is to comply with the requirements of Part VIII "Pumping and Piping" of the RS rules. Several overflow pipes may be combined into one pipe with an appropriate increase of the diameter. In this case, however, liquid radioactive waste overflow from one tank into another through the overflow system, when one of the tanks is overfilled or at heavy lists of the vessel is not allowed. A separate tank is to be available and provided with biological shielding, if necessary, for medium-activity waste overflow from the tanks through an independent system. It can be located in the same space where the medium-activity storage tank is arranged. Air pipes of different activity liquid waste overflow tanks located within one watertight compartment may be combined with air pipes of the appropriate tanks.

The overflow system of each liquid radioactive tank is to be provided with a device signalling the waste overflow. The device is to be of adequate strength or to be protected against possible damages. In addition to the signalling means required by Part VIII "Pumping and Piping" of the RS Rules, the overflow tank is to be provided with a low level alarm for the case referred to in 7.1.2.4 of the Rules. All indications and alarms are to be led in the main handling operations control room and valve control station.

7.1.1.10 Remote-controlled shut-down valves of sylphon type with local position indicators and information display in the main handling operations room and valve control station are to be fitted on the air pipes of liquid

radioactive waste storage tanks where excessive pressure might arise. The valves are to be permanently open and to be closed only in the course of handling operations which involve pressure increase in the tanks.

It is recommended that these valves be interlocked with fittings for compressed air (gas) supply to the tanks to squeeze liquid radioactive waste out of the tanks, thus preventing air (gas) supply into the tanks when the valves on the air pipes are open. The excessive air is to be discharged either in the space where the tanks are located or directly into the exhaust part of the special ventilation system equipped with filters providing the required cleaning effect.

The tanks are to be properly protected against inadmissible pressure increase. Where the tank structure and protection (see 7.1.1.5.9 of the Rules) fail to prevent active water ejection in the course of the handling operations, the excessive air (or air-water mixture) is to be discharged into a special drain tank or another insulated tank.

7.1.1.11 The requirements of Part VIII of the RS Rules, where they are not in conflict with the Rules, are also applicable to the liquid radioactive waste storage tanks and their air and overflow pipes.

7.1.2 Liquid Radioactive Waste Systems.

7.1.2.1 Pipes of liquid radioactive waste reception, treatment and removal systems are to be independent of other piping and are to be made of corrosion-resistant materials. Pipe connections with other pipes and fittings are to be welded. Fittings of these systems are to be of bellows type.

Independent pipes are to be provided for reception, pumping and discharge of medium- and low-activity liquid radioactive waste.

7.1.2.2 Liquid radioactive waste reception on board, transfer from one tank into another or treatment and removal are to be only forced (except overflow and leak collection systems). Liquid radioactive waste may be conveyed either by electric pumps of watertight construction or by compressed air (gas) supply directly to the liquid radioactive tanks of a nuclear ship or nuclear support vessel. In the latter case, the system supplying compressed air (gas) to the liquid radioactive waste tanks is to provide working medium supply both from vessel's own sources and from outside.

7.1.2.3 When electric pumps are used for liquid radioactive waste reception and discharge, provision is to be made on board for at least two glandless pumps of watertight construction, preventing active water leakages in the course of treatment. A bypass system automatically preventing pressure increase in the pipe (in case quick-closing devices on the discharge pipe operate) is to be provided for each pump.

The pumps are to be arranged in a special pump room. At least two pumps totally independent of the low-activity radioactive waste system are to be provided for medium-activity waste pumping. These pumps are to be installed either in adequately shielded special spaces or to be provided with additional biological shielding screens.

The pumps are to be started and stopped, and their operation is to be monitored from the control position located outside the pump room (at the valve control station) and from the main handling operations control room, which are to have two-way communication between themselves, with the served ship and with the shore.

The pump room equipment and arrangement are to comply with the requirements of Section 5 of the Rules.

7.1.2.4 Where electric pumps for liquid radioactive waste transfer are designed in such a way that their operation requires priming with working medium, their start is to be interlocked with an indicator showing availability of water in the pumps, and their stopping — with a low level alarm for liquid radioactive waste storage tanks.

7.1.2.5 The liquid radioactive waste system is to provide waste reception and discharge on either side, using both the served ship's facilities and vessel's own facilities. The waste discharge outside the vessel is to prevent contamination of the vessel itself and the environment. Liquid radioactive waste reception and discharge fittings are to be combined in common reception-discharge stations located on either side, to be local- and remote-controlled and to have position indicators.

Liquid radioactive waste fittings and pipes are on the entire length to be provided with biological shielding, where necessary. Removable lines of an approved design are to be used for liquid radioactive waste reception and discharge from one ship to another and to the shore. The station equipment is to prevent liquid radioactive waste spillage in the course of transfer or in emergencies involving damage of the lines. Provision is to be made for quick-closing isolating devices for prompt isolation of the pipes in case of breaks or spontaneous disconnection of removable lines. It is recommended that such devices should automatically operate when an alarm on pressure drop in the system operates.

The liquid radioactive waste reception — discharge station is to have:

.1 tight closure of all openings in the vessel's outside structures (sides, upper deck);

.2 connection of pipes for washing and decontamination of the station room, its equipment and systems;

.3 connections for compressed air supply for purging and emptying of liquid radioactive waste systems and removable lines;

.4 heating system preventing icing where leaks are likely to occur in the course of handling operations carried out in winter time and freezing of the systems themselves;

.5 twin mechanical filters on waste reception — discharge pipe;

.6 fairly high coamings in side openings to prevent liquid radioactive waste from flowing overboard in case of leakages or damages or spontaneous disconnection of removable lines. The places for removable line connection are to be well away from outside openings; means are to be provided for fixing the lines and preventing them from dropping overboard;

.7 handling devices for lines transfer outside and their reception back;

.8 tight local barriers to contain likely spillages of liquid radioactive waste, the barriers are to be of adequate height, which, however, should not impede the personnel;

.9 connection of vacuum drying system;

.10 means for measuring activity of received and discharged liquid radioactive waste;

.11 necessary biological shielding where equipment and systems are arranged.

All detachable equipment is to be kept in special spaces located next to the stations. All materials used in the station structures and equipment installed or coatings used therein are to be resistant to corrosive media and to be suitable for multiple decontamination.

7.1.2.6 Provision is to be made for removable lines flushing and drying by supplying flushing water and compressed air to the liquid radioactive waste discharge system after the last bellows valve. Fittings of the flushing water and compressed air supply systems are to be of non-return shut-down type and to be installed directly on the liquid radioactive waste pipeline. All connections of removable lines are to be of quick-release type, but preventing any liquid radioactive waste leaks.

A possibility is to be available to test the removable lines for leak tightness upon their assembly before operations begin.

7.1.2.7 In order to reduce contamination of pipes and storages, mechanical filters or other water cleaning means are to be installed in the suction and discharge parts of the liquid radioactive waste transfer system.

Provision is to be made for safe replacement of mechanical filters and their transportation to the storage.

7.2 SPECIAL BILGE SYSTEM

7.2.1 A special bilge system, independent of the vessel's systems is to be provided for drainage of the controlled area spaces.

7.2.2 Drainage and bilge systems of sealed spaces are to be provided with means capable to ensure an appropriate sealing level of the spaces.

Used as such means may be shut-down valves installed on suction pipes of the bilge system of the sealed spaces. The valves are to have local and remote position indicators with information displayed in the main handling operations control room and valve control station. It is recommended that these valves be remote controlled (the drive is to be located outside the sealed space).

7.2.3 The bilge system from the controlled area spaces is to be of closed-circuit type and to be equipped with special built-in tanks for waste active water collection and storage and scuppers provided with a valve and its closed position indicator. Waste water bilge wells in the controlled area spaces are to be equipped with water-presence indicators with information displayed in the main handling operations control room.

Waste water drainage by gravity is allowed into the spaces below of the same category (in terms of ionizing radiation and radioactive contamination) where the decks (platforms) of these spaces are not watertight. Otherwise the pipes of water intake from the bilge wells are to be equipped with non-return shut-off valves.

The design of the bilge wells is to comply with the requirements of 7.1 of the Rules.

7.2.4 The throughput of the bilge pipes and scuppers is to provide fast water removal from the spaces. The scuppers are to be arranged so as to prevent stagnant areas formation in any operating position of the vessel hull.

7.2.5 The spaces located above the bilge tank level may be drained by gravity. To prevent bilge water from flowing back and its discharge into other spaces through scuppers in case the tanks are overfilled, non-return valves are to be installed on the bilge pipes or valves on the scuppers are to be of non-return shut-off type.

Other isolating means are not allowed to be installed on bilge pipes except the systems serving the spaces which are parts of the sealed areas (see 7.2.3 of the Rules).

7.2.6 For drainage of the controlled area spaces located at the level of the bilge tanks or below, vacuum-drainage or another method of total bilge

water removal is to be used. Vacuum drainage is also recommended for the spaces above the controlled area. For vacuum drainage of the spaces provision is to be made for a vacuum pump of the type approved by the Register with a suitable tank for vacuum creation. The pump is to be controlled, its operation and vacuum in the vacuum tank are to be monitored from the local station and main handling operations control room. For drainage of concealed areas use is to be made of hoses with slot nozzles, and places for their connection are to be provided. Provision is to be made for vacuum drainage of boxes, containers and other facilities for spent fuel assemblies individual storage and transportation.

7.2.7 Bilge waters of different radioactivity level, as well as alkaline and acid decontamination waters are to be segregated. Bilge collecting tanks for medium-activity water storage are to be shielded.

Medium-activity water tanks and pipes are to be concentrated in places most distant from crew accommodation spaces and other spaces where people permanently stay.

7.2.8 The design of bilge collecting tanks is to comply with the requirements of 7.1.1 of the Rules.

Bilge collecting tanks and vacuum tank are to be fitted with level indicators with lower level light signalling and upper level light and sound signalling led to the main handling operations control room, washing and entire drainage facilities and sampling devices. Besides, bilge tanks are to be provided with air pipes in compliance with 7.1.1.8 and 7.1.1.11 of the Rules.

Air pipes may be combined only within one watertight compartment and only for bilge tanks referring to one volumetric activity category.

Where controlled area spaces are drained by gravity, the air pipes of bilge tanks are to be led above the deck of the uppermost drained space. In case of vacuum drainage, the air pipes of the bilge tanks are to be led to the deck where the vacuum pump tank is installed.

7.2.9 Bilge tanks are to be drained by glandless electric pumps of watertight construction, having adequate capacity, or by squeezing water with compressed air (gas) or other means approved by the Register.

Where compressed air (gas) is used, excessive pressure increase is to be prevented in the bilge tanks (see 7.1.1.10 of the Rules).

7.2.10 The vacuum pump tank is to be drained into a special bilge system or directly into the liquid radioactive waste tank. Where the vacuum tank is drained with compressed air, a safety device is to be provided preventing inadmissible pressure increase therein.

7.3 DECONTAMINATION AND SPRAYING SYSTEMS

7.3.1 Technical means are to be provided on board the nuclear support vessels for radioactive contamination removal as well as for containment and immobilization of not easily removable radioactive contaminants. The means to be used depend on the particular purpose of the vessel and are subject to the Register's consideration in each particular case.

7.3.2 For decontamination and washing of the spaces, tanks, handling equipment and vessel's structures where radioactive contamination might arise, decontamination and washing systems are to be provided. The systems are to include storage tanks for concentrated ingredients of decontaminating solutions, solution-making stations, pipes to supply solutions, washing water, high-purity water and steam to decontaminated objects and pipes for decontaminating water drainage into collecting tanks, different for acid and alkaline waters.

7.3.3 For needs associated with preparation of decontaminating solutions and washing of decontaminated surfaces, process water supply system is to be provided to supply water to the solution-making stations and appropriate process spaces. Washing water may be drained to a bilge tank of the special bilge system.

7.3.4 Decontaminating water (alkaline and acid) bilge tanks are to be of built-in type. Their design is to comply with the requirements of 7.1.1 of the Rules. Besides, they are to be provided with fittings and pipes for spraying water supply thereto and internal spraying facilities.

7.3.5 The system of acids and alkalis reception and their supply to the decontaminating solution-making station is to be safe in operation and prevent their spillage. Liquid components are to be supplied to the storage tanks by a closed-circuit method. The liquid component and ready solution storage tanks are to be of built-in type, and their design is to comply with the requirements of 7.1.1 of the Rules. These tanks are to be made of materials suitable for agressive alkaline and acid media storage and to be located in insulated spaces equipped with spraying system and exhaust ventilation.

Where dry components are used for making decontaminating solutions, they are to be kept in watertight package in special store rooms equipped with exhaust ventilation and located in the vicinity of the solution-making station. Acid and alkaline components are to be kept separately. They are to be supplied to the solution-making tanks from outside.

7.3.6 The decontaminating solution making station and associated storerooms and storage facilities are to be located outside the controlled area. Where many equipment items are to be decontaminated, provision is to be made on the nuclear support vessels for a special decontamination space located within the controlled area and equipped with baths, racks and local decontamination stations, where decontaminating solutions, process water, steam and compressed air supply is to be provided. Besides, local cargo-handling gear, grips, stoppers, platforms and similar items necessary for large-sized equipment transportation and handling are to be provided.

The nomenclature of decontamination space equipment is decided by the vessel's designer and is subject to approval by a competent authority.

Decontamination space and equipment installed therein are to have corrosion-resistant coating or to be made of appropriate materials.

Decontamination space is to be also equipped with facilities of communication with the main handling operations control room and exhaust ventilation from all local decontamination stations and baths, which is capable to provide the required number of air changes. Filters for exhaust air cleaning are to be fitted in the ventilation system.

7.3.7 The components and ready decontaminating solutions are to be pumped with special facilities to be controlled from local stations.

7.4 COMPRESSED AIR AND GAS SYSTEMS

7.4.1 For process needs provision is to be made on a nuclear support vessel for special compressed air or gas supply systems segregated from the vessel's similar systems. In order to supply compressed air to the system, an independent air compressor of appropriate parameters and capacity is to be provided and installed outside the controlled area. Compressed air from the compressor is to be supplied through a non-return shut-off valve to an intermediate air receiver installed in the controlled area, a non-return shut-off valve is to be installed directly on the bulkhead bounding the controlled area and to be located outside the controlled area.

For redundancy purposes and/or in case of small compressed air consumption for process needs, it is allowed to supply the air from the vessel's system. In this case, the air is also to be supplied to an intermediate air receiver installed in the controlled area through a non-

return shut-off valve (for its installation, see above). A reducing valve and a safety valve are to be installed directly before the non-return shut-off valve (outside the controlled area), where necessary.

The equipment and installation of the intermediate air receiver are to comply with the requirements of Part X "Boilers, Heat Exchangers and Pressure Vessels" of the RS Rules.

7.4.2 Connections of compressed air and gas pipes with other pipes and with fittings within the controlled area are to be welded. The pipes and air receivers are to be made of materials allowing multiple decontamination or they are to have an appropriate coating. Apart from shut-down valves, non-return valves are to be installed on the open ends of the pipes.

Provision is to be made for a branch pipe (pipe connection) for compressed air or gas delivery from the outside. The branch pipe (connection) is to be installed before the non-return valve outside the controlled area.

7.4.3 Compressed air (gas) in contact with radioactive compounds, upon being used, is to be removed through air ducts of the special ventilation system.

7.4.4 Gas bottles of non-explosive process gases (nitrogen, helium) are to be installed in specially equipped spaces in special groups connected to the appropriate pipes. Connection to standard transport cylinders is allowed. The space where the gas bottles are installed is to provide their protection against heating from foreign sources. The location of such spaces and exits therefrom is to be such that personnel can quickly leave the space in case of oxygen-replacing gases spontaneous release therein. The space is to be located outside the controlled area.

7.4.5 Where provision is made for gas (nitrogen, helium) storage in fixed gas bottles, their equipment and installation are to comply with the requirements of Part X "Boilers, Heat Exchangers and Pressure Vessels" of the RS Rules.

7.4.6 Provision is to be made for periodical surveys and hydraulic tests of fixed air and gas bottles without dismantling thereof.

7.4.7 The equipment necessary for process gases (nitrogen, oxygen, acetylene, etc.) generation and storage as well as for gas and electric welding is to be located outside the controlled area. The equipment installation on board a nuclear support vessel is subject to special consideration by the Register.

7.4.8 Process gases are to be supplied through independent pipes to independent and segregated stations and then directly to work areas through removable pipes.

7.4.9 Provision is to be made for receiving of non-explosive process gases (nitrogen, helium) from the outside or their transfer to the serviced ship or to the shore through separate detachable pipes.

The gas transfer is to be forced. Installation of vessel's gas compressors is to comply with the requirements of these Rules and those of Part IX "Machinery" of the RS Rules.

7.5 SPECIAL VENTILATION SYSTEM

7.5.1 An independent special ventilation system is to be provided for spaces where radioactive contamination might occur. In addition to the requirements of this Chapter, the system is to comply with the requirements of Part VIII "Pumping and Piping" of the RS Rules as far as they are not in conflict with these requirements.

7.5.2 The special ventilation system in spaces where radioactive contamination might occur, is to be made of materials suitable for multiple decontamination. The number of flanged connections in the system within the controlled area is to be minimized. No flanged connections, holes, etc. are allowed outside the controlled area.

7.5.3 The special ventilation system may be combined (supply-exhaust) or only exhaust system with air flowing through the spaces. In any case, however, ventilating air is to flow in the direction of spaces with higher airborne contamination by creating appropriate vacuum therein.

The special ventilation system may not be combined with other systems, including a heating system of served spaces where air heaters are used. It is not recommended that the system be combined with the nuclear support vessel's ventilation system.

7.5.4 Air intakes are to be provided with filters to prevent dust or foreign particles penetration into the controlled area spaces. After cleaning, the air is to be discharged through a special ventilation mast, the height of which is to provide efficient controlled area air removal from outside structures of the vessel.

In any case, however, air discharged from the special ventilation system is to be prevented from re-entry into air intakes of the vessel's ventilation.

Devices for continuous monitoring of the discharged air volume and activity are to be provided at the ventilation mast outlet.

7.5.5 The categories of spaces equipped with supply and exhaust ventilation, pressure and vacuum in the spaces, the number of air changes

are to comply with the requirements of the current Sanitary Rules for nuclear support vessels.

Ventilation ducts of the controlled area spaces of different categories in terms of radioactive contamination or ionizing radiation level are to be segregated.

The ventilation system of the spaces where spent fuel assemblies storage facilities are located or where high-activity waste is or may be kept is to provide air temperature in these spaces not in excess of 55°C, unless other requirements for spent fuel assemblies and high-activity waste storage conditions are specified.

7.5.6 When the ventilation system is not in operation, the air is to be prevented from flowing through the ventilation ducts from spaces of higher contamination to those of lower contamination.

7.5.7 Where necessary, the special ventilation system is to be fitted with twin filters for discharged air cleaning from aerosols and other radioactive particles. In this case, any possibility of air discharge bypassing the filters is to be prevented.

7.5.8 Redundancy of supply and exhaust ventilation fans and heat exchangers of the special ventilation system is to be provided. It is recommended that stand-by fans should start automatically in case of failure of running fans. The main pipe fittings are to be remote controlled from the spaces outside the controlled area.

7.5.9 Exhaust duct filters of the special ventilation system are to be provided with spare filtering cartridges, be readily accessible and provided with appliances for their safe replacement.

7.5.10 General control of the special ventilation system is to be effected from the main handling operations control room. Local control stations are to be provided to control separate parts of the systems.

It is recommended that provision be made for interlocking of electric fans start and stop with opening and closing of the appropriate fittings.

7.5.11 In spaces intended for high-activity materials storage or treatment as well as in places of likely release of gases or aerosols, local air extraction directly from work places is to be arranged. In this case, the first cascade of aerosol filters may be located in the same space.

7.5.12 All ventilation system components (ventilation ducts and pipes, filter bodies, etc.) are not to hinder decontamination of the adjacent structures and equipment.

7.5.13 Upon its manufacture and installation on board, the special ventilation system is to be tested for leak tightness.

Periodic tests of the special ventilation system for leak tightness are not required; the tests, however, are to be carried out after repairs with replacement of its tight components, such as portions of the ducts, fittings, etc. After replacement of filtering elements local tightness checks of the system in operation are sufficient.

7.5.14 Emergency ventilation system is to be provided for radioactive gases and aerosols concentration quick reduction in enclosed spaces of the vessel. As the emergency ventilation mobile filtering and recirculation unit or another arrangement of the type approved by the Register may be used. The capacity and number of air changes to be provided by the emergency ventilation system as well as its filters resolving power are governed by the volume of the controlled area largest enclosed space where the highest concentration of radioactive gases or aerosols might occur. The emergency ventilation system is to be started from the main handling operations control room. Where a mobile unit is used as an emergency ventilation system, it is to be local- and remote-controlled.

8. ELECTRICAL EQUIPMENT

8.1 GENERAL PROVISIONS

8.1.1 The requirements of this Section cover electrical units and equipment of nuclear support vessels and are additional to the requirements of Part XI "Electrical Equipment" of the RS Rules and Part X "Electrical Equipment" of the Rules for Nuclear Powered Ships.

8.1.2 Electrical equipment installed in the controlled area spaces is to have protective enclosure not lower than IP56, and radiation monitoring sensors — IP68.

8.2 EMERGENCY SOURCES OF ELECTRICAL POWER

8.2.1 An independent emergency source of electrical power is to be installed on each nuclear support vessel. Its capacity is to be sufficient for feeding the consumers referred to in 8.2.2 of the Rules.

A diesel-generator is to be used as an emergency power source.

On non-self-propelled vessels of a simple design, permanently lying at berths and referred to the category of berth-connected ships (floating

radiation monitoring stations, special-purpose sanitary stations, etc.) as well as on self-propelled ships of restricted service, not having nuclear fuel, liquid or solid radioactive waste (floating warehouses, heating vessels, etc.), a necessity to provide an emergency source of electrical power, its type and capacity are subject to special consideration by the Register.

8.2.2 In addition to the consumers referred to in Part XI "Electrical Equipment" of the RS Rules, the following consumers are to receive electrical power from emergency switchboard busbars fed by the emergency generator, directly or through a transformer, from separate feeders:

.1 electric drives of pumps of all cooling circuits for spent fuel assemblies storage facilities;

.2 electric drive of one of the washing water pumps for the special-purpose sanitary space;

.3 electric drives of fans for the emergency ventilation system and air supply to pneumatic suits;

.4 signalling of closing the doors to the controlled area;

.5 emergency lighting, alarm system and internal communication in the controlled area spaces according to the requirements of these Rules;

.6 radiation monitoring and nuclear hazard occurrence fixed devices, in case they are supplied from the vessel's electrical system;

.7 control, monitoring and signalling positions in the valve control and handling operations control stations.

8.3 ELECTRICAL POWER DISTRIBUTION

8.3.1 Power to consumers in the controlled area spaces is to be supplied from special distribution boards located outside the controlled area.

8.3.2 Power to consumers providing heat extraction from the spent fuel assemblies storage facilities, their condition signalling and monitoring systems, including radiation monitoring, is to be supplied from two feeders, one of which is supplied through the emergency switchboard.

8.3.3 Starting arrangements of electric drives of cooling circuits of the spent fuel assemblies storage facilities are to ensure automatic re-start of electric motors when voltage is restored after power supply interruption.

8.3.4 Each consumer serving the controlled area spaces and arrangements, which is supplied from two different sources of electrical power or from two feeders, is to be fitted with an automatic power switch.

8.3.5 Provision is to be made for power supply to the vessel's electrical system from an outside source of electrical power, for that purpose a

switchboard for shore power connection is to be installed on board. In addition to the devices required by Part XI "Electrical Equipment" of the RS Rules, a minimum voltage protection device is to be provided on the switchboard. Additional shore power switchboards may be installed, where necessary, location of which relative to each other is to be governed by the vessel's basing conditions.

8.4 CABLING

8.4.1 Electric cable penetrations of the controlled area spaces are to be as close to electrical equipment as possible. Cables are to be laid on the shortest routes possible.

8.4.2 Transit cables are not allowed to run through the controlled area spaces. Where, however, it will be deemed necessary (structurally impossible to get around these spaces, etc.), the cables are to be laid in tight conduits, linings or ducts. Use of cables with outside wire braiding is not allowed.

8.4.3 Packing cable boxes and individual cable glands are to be installed from the "cleaner" space side as far as it is practicable. In this case, a clearance on the opposite side is to be filled in with cable compound to the thickness of protective layer.

8.4.4 Bunched cables outgoing from cable boxes are to be coated with cable compound at a distance of 100 mm on either side. It is recommended that single-row installation of cables be used to provide their proper radioactive decontamination, and power cables, and monitoring and signalling device cables be segregated.

8.4.5 Bunched and individual cables are to be laid at a distance of at least 60 mm from bulkhead surfaces, decks, framing and other hull structures.

8.4.6 Installation of individual or bunched cables behind electrical equipment is not allowed.

8.4.7 All fitter tools for electrical equipment and cabling are to be of simple design and to have corrosion protection. Use of perforated parts and products is not allowed.

8.5 LIGHTING

8.5.1 Controlled area spaces are to have at least two lighting groups fed from separate feeders.

8.5.2 Group boards of main lighting for controlled area spaces are to have remote on/off switching with appropriate signalling.

8.5.3 Emergency lighting fixtures are to be installed for lighting of:

.1 radiation monitoring positions;

.2 valve and handling operations control rooms;

.3 spent fuel assemblies storage rooms;

.4 special-purpose sanitary space;

.5 main passages in the controlled area spaces.

8.6 INTERNAL COMMUNICATION AND SIGNALLING

8.6.1 Provision is to be made for two-way loudspeaking and telephone communication of the main handling operations control room with:

.1 wheelhouse;

.2 machinery space;

.3 valve control station;

.4 observation station in the new fuel assemblies storage room;

.5 handling operations observation station in the spent fuel assemblies storage room;

.6 decontamination space;

.7 radiation monitoring station;

.8 special-purpose sanitary room.

8.6.2 Provision is to be made for two-way loudspeaking or telephone communication of the main handling operations control room with the repairs control room of the serviced ship.

8.6.3 All closures in ship structures bounding the controlled area are to be provided with signalling of their opening, and information is to be displayed in the main handling operations control room or at the radiation monitoring station. It is recommended that local audible signalling of door or other closure opening be installed.

8.6.4 In the controlled area process spaces permanently or periodically attended by personnel a signalling system is to be provided to warn personnel of a necessity to urgently leave the controlled area spaces. The system is to include light panels with appropriate text in the controlled area main spaces and sound signals to be clearly heard in all spaces, different in tone from all other signals. The warning alarm system is to be started from the main handling operations control room or radiation monitoring station. Switches which put the system into operation are to be prevented from unauthorized access thereto.

8.7 ELECTRICAL COMPONENTS OF RADIATION MONITORING

8.7.1 Electrical power to fixed components of radiation monitoring is to be supplied from the main and emergency switchboards. Where these components and systems are fed through converters, they are to be at least two in number, located on either side, and automatically switched over.

8.7.2 Power supply of radiation monitoring components is to be automatically switched over to the emergency source.

8.7.3 Power supply system of radiation monitoring components is not to be used for any purpose other than for intended use.

9. RADIATION SAFETY

9.1 RADIOLOGICAL PROTECTION

9.1.1 In order to ensure radiation safety of the crew and environment biological shielding of spent fuel assemblies, solid, liquid and gaseous waste storage facilities and other possible radiation sources (pipes, wires, machinery, equipment, etc.) is to be provided.

Biological shielding for spaces and individual equipment is to be calculated on the basis of the maximum radiation level possible for the particular space or equipment, using the magnitudes specified in the national Sanitary Rules and State Radiation Safety Standards.

The biological shielding design is to efficiently provide a possibility of carrying out any docking works on the vessel's hull and arrangements.

9.1.2 The controlled area is to be enclosed on board the ship. Entrance to the controlled area is to be allowed only through the special-purpose sanitary space equipped with clothes changing facilities, dose rates recording facilities, washing equipment.

9.1.3 The controlled area spaces are to be sub-divided into categories as regards probability and level of radioactive contamination.

Air vacuum in the spaces (or groups of spaces), air humidity, temperature and number of air changes are to be provided by the vessel's special ventilation system and to be consistent with the national Sanitary Rules in force.

9.1.4 Where air flows from one space to another, the flow is to be from areas of lower potential airborne contamination to areas of higher potential airborne contamination.

9.1.5 Air discharged from the controlled area spaces is to be continuously monitored and is to pass through efficient filters.

The controlled area ventilation system is to be designed so as to prevent contamination of the spaces where people can stay and in the spaces of radioactive materials accumulation. The ventilation is to be effected through a special ventilation mast. The activity of the special ventilation system emissions is not to exceed the rates specified in the national Sanitary Rules and Radiation Safety Standards.

9.1.6 Personnel individual protection means and systems providing their use are to be available.

9.1.7 In order to prevent accumulation of radioactive contamination, provision is to be made for decontamination of all controlled area spaces, equipment installed therein as well as of the vessel's hull, including its outer surfaces. Coatings and paintings of the structures are to allow multiple decontamination.

9.1.8 The controlled area spaces configuration is to be simple, without recesses and projecting parts as far as practicable. Corners of hull structures are to be rounded as far as it is practicable, surfaces and welded joints are to be smooth.

9.1.9 Machinery and equipment not suitable for decontamination are to be easily replaceable.

It is recommended that a provision be made for covering this machinery and equipment in operation.

9.2 RADIATION MONITORING

9.2.1 Nuclear support vessels are to be provided with radiation monitoring means.

9.2.2 Depending on the purpose of a nuclear support vessel radioactive monitoring means may include:

.1 fixed centralized monitoring system;

.2 fixed monitoring units and instruments;

.3 portable radiometric and radiation monitoring instruments.

9.2.3 The number and nomenclature of radiation monitoring instruments and their location on board a nuclear supply vessel are to be approved by the Register.

9.2.4 Radiation monitoring means are to provide:

.1 monitoring of ionizing radiation dose rates on board;

.2 monitoring of equipment and spaces radiocontamination level;

.3 monitoring of radioactive emissions into the atmosphere through the nuclear support vessel ventilation system;

.4 monitoring of liquid radioactive waste volumetric activity and amount on board a nuclear support vessel;

.5 environmental monitoring in spent and new fuel assemblies storage facilities in the nuclear support vessels intended for nuclear fuel handling;

.6 signalling on position of all closing appliances in the structures bounding the controlled area;

.7 individual radiation monitoring of the personnel.

9.2.5 Radiation monitoring means are to provide record and storage (depending on the purpose of the nuclear support vessel) of:

.1 ionizing radiation levels on board;

.2 radioactive contamination levels for spaces;

.3 amounts and volumetric activity of radioactive waste stored on board and discharged from the ship to the environment;

.4 magnitudes of individual doses for personnel.

9.2.6 Where the centralized radiation monitoring is available on board, the radiation monitoring station is to be located either in the vicinity of the main handling operations control room or to be combined therewith.